NEVADA DEPARTMENT OF TRANSPORTATION

RESEARCH PROBLEM STATEMENTS

Internal Submission Form (Not to exceed 3 pages with font size 12)

I. PROBLEM TITLE:

Developing a Lower Modulus Polymer Resin Binder Systems Specifications for High Friction Surface Treatment (HFST) on Asphalt Pavements in Nevada

II. PROBLEM DESCRIPTION:

Many mechanisms can contribute to premature failure of High Friction Surface Treatments (HFST), especially on asphalt pavements with lower relative tensile strength and cohesive properties than the HFST system was designed for. Nevada Departments of Transportation regularly specify the Thin Bonded Overlay application to require material properties of the polymer resin binder used as a key component of the HFST system. Thermal incompatibility between HFST and asphalt pavement is a primary contributor to early age failure of such treatments. Along with thermal compatibility, modulus as well as heat deflection properties play a role in the change in strength of the resin binder system during higher temperature service conditions to prevent the loss of aggregates.

III. OBJECTIVE:

The outcome should produce the specifications for a material with lower tensile strength, higher tensile elongation, a higher heat deflection temperature/glass transition temperature and better UV stability. This should also increase the thermal compatibility and longevity of the treatments with the pavements they are being installed on.

IV. CURRENT PRACTICE and RELATED RESEARCH:

Although some research has been done to bring light to various contributors, nothing has been developed regrading test methods that connect how to properly off-set the thermal variances that contribute to early failures. It can be concluded that these factors play a crucial if not a dominate role in such failures as de-bonding, spalling and cracking of these HFST systems. Some test methods have been considered to determine that the glass transition (Tg) and heat deflection properties of the resin binder are satisfactory enough to handle the service conditions of HFST and minimize the potential for aggregate loss.

ASTM D695 - Standard Test Method for Compressive Properties of Rigid Plastics
ASTM D638 - Standard Test Method for Tensile Properties of Plastics

This research should consider the following:

1. The HFST resin binder systems can have up to a 5 times greater coefficient of thermal expansion than the pavement they are bonded to.
2. These HFST systems are often installed on asphalt pavement that are low in tensile strength, in poor condition, and often near the end of their life-cycle. De-bonding, spalling and reflective cracking are common failure mechanisms that can be attributed to this.

3. Most polymer systems become very flexible and soft at higher ambient temperatures, so lowering the tensile strength requirements without raising the requirement for a heat deflection/ glass transition temperature is not recommended.
4. The potential for loss aggregate through stresses exhibited from service during hot summer conditions also need to be addressed when considering lowering the modulus properties of the resin binder.

V. RESEARCH METHODOLOGY:

The first goal would be to determine that a standard or modified ASTM test method can be used to measure the heat deflection and/or glass transition (Tg) temperature of the resin binder systems that correlates to minimize the potential for loss of aggregate when in service under hot summer conditions.

Consider a test such as a three-wheel polishing device cycling over HFST specimens at temperatures as high as 160°F, or similar proposed temperatures to replicate HFST when in service on asphalt pavement temperatures in the hottest climates where they are being used in southern Nevada.

Have industry provide products designed for this intent to qualify that aggregates will not be lost through the proposed number of cycling with the three- wheel polishing device at the proposed temperature.

Once a determination is made product(s) are available that will not lose aggregate under the three -wheel polishing test (and/or another method capable of replicating field conditions), test the product(s) in accordance to the ASTM method to measure heat deflection/Tg. This testing requirement can be added to the material property table along with the lower, proposed modulus and tensile properties to qualify the resin binder systems.

VI. IMPLEMENTATION POTENTIAL:

This research is to determine test methods that could be used within the specification format to better qualify materials for high friction surface treatments. The outcome of this research will dramatically reduce the potential for the failure of these treatments that are valued as a safety countermeasure for preventing crashes and saving lives.

VII. URGENCY AND PAYOFF POTENTIAL:

The desired outcome of this study would be to make recommendations for test methods and acceptance criteria aimed at the development of better standards for polymer resin binder systems used in HFST. This would also better relegate how the manufacturers of such systems design them for HFST being used on asphalt pavements in different climates.

VIII. ESTIMATED BUDGET:

$150,000 and 28 month

IX. DATE AND SUBMITTED BY:

Materials and Traffic Safety Engineering Division.